

Exhibit 3

(Part 2 of 2)

RECEIVED

MAR 15 2017

LAND PROTECTION DIVISION
DEPARTMENT OF ENVIRONMENTAL QUALITY

CLOSURE PLAN
FOR
GRAND RIVER DAM AUTHORITY LANDFILL
GRAND RIVER ENERGY CENTER
MAYES COUNTY, OKLAHOMA
SOLID WASTE PERMIT NO. 3549012

PREPARED FOR:
GRDA
Grand River Dam Authority
GRAND RIVER DAM AUTHORITY
VINITA, OKLAHOMA

OCTOBER 11, 2016

A&M PROJECT NO. 1986-018

PREPARED BY:

A&M ENGINEERING AND ENVIRONMENTAL SERVICES, INC.
10010 E. 16TH STREET
TULSA, OKLAHOMA 74128-4813
PHONE (918) 665-6575 & FAX (918) 665-6576
EMAIL: aandm@aandmengineering.com

**CLOSURE PLAN
GRAND RIVER DAM AUTHORITY LANDFILL
GRAND RIVER ENERGY CENTER
MAYES COUNTY, OKLAHOMA**

TABLE OF CONTENTS

SECTION	PAGE
CERTIFICATION STATEMENT.....	ii
1.0 INTRODUCTION	1
2.0 CLOSURE PLAN [40 CFR 257.102(b)].....	2
2.1 Final Cover System [40 CFR 257.102(b)(iii)]	2
2.2 Final Certification and Survey	4
2.3 Estimated Maximum Inventory of CCR [40 CFR 257.102(b)(iv)].....	4
2.4 Estimated Maximum Area of Cover [40 CFR 257.102(b)(v)].....	4
2.5 Schedule of Closure and Required Notifications [40 CFR 257.102(b)(vi)].....	5
2.6 Closure Cost Estimates and Financial Assurance	7
3.0 PLAN AMENDMENTS AND REVISIONS	7
4.0 RECORDKEEPING REQUIREMENTS	7
5.0 OTHER NOTIFICATION REQUIREMENTS	7
6.0 CCR WEBSITE REQUIREMENTS	7
7.0 REFERENCES	8

FIGURES

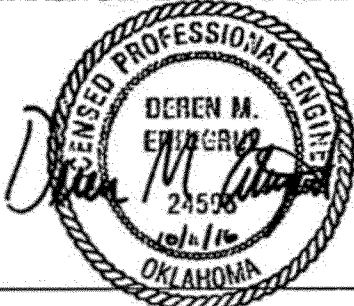
FIGURE 1 GRDA Landfill Closure Contours



CERTIFICATION STATEMENT

I certify that this Closure Plan was prepared under my direction or supervision in accordance with good engineering practice and the requirements of 40 CFR §257.102 for the GRDA Landfill located within the Grand River Energy Center complex in Mayes County, Oklahoma. Based on the information reviewed, this report is to the best of my knowledge and belief, true, accurate and complete.

A&M ENGINEERING AND ENVIRONMENTAL SERVICES, INC.



Deren M. Ertugrul, P.E.

Oklahoma Registration No. 24595

10/11/2016

Date



**CLOSURE PLAN
GRAND RIVER DAM AUTHORITY LANDFILL
GRAND RIVER ENERGY CENTER
MAYES COUNTY, OKLAHOMA**

1.0 INTRODUCTION

The Grand River Dam Authority (GRDA) owns and operates the Grand River Energy Center (GREC) electric generating station located approximately three (3) miles east of the City of Chouteau in Mayes County, Oklahoma. Two (2) coal fired boilers are operated at GREC which produce Coal Combustion Residuals (CCRs) consisting of fly ash and bottom ash. Fly ash comprises greater than 80% of CCRs generated at the facility and is largely sold for beneficial use purposes. Excess fly ash and bottom ash is disposed at a permitted coal ash landfill, herein referred to as the GRDA Landfill, located within the GREC complex.

The GRDA Landfill is permitted by the Oklahoma Department of Environmental Quality (DEQ) as a Non-Hazardous Industrial Waste Landfill that is allowed to accept fly ash, bottom ash and spent powdered activated carbon used to control flue gas emissions, generated at the GREC (DEQ, 2015). The GRDA Landfill is situated south of the coal fired boiler units within the GREC complex and has been in operation since 1982. The total landfill permit area consists of approximately 116 acres, of which only 69.5 acres is available for use. 47 acres have been utilized for CCR disposal to date.

This written Closure Plan has been prepared to satisfy the requirements of 40 CFR 257.102(b) which requires existing CCR landfills to prepare *“a written closure plan that describes the steps necessary to close the CCR unit at any point during the active life of the CCR unit consistent with recognized and generally accepted good engineering practices. The written closure plan must include, at a minimum, the information specified in paragraphs (b)(1)(i) through (vi) of this section.”*



2.0 CLOSURE PLAN [40 CFR 257.102(b)]

Closure of the GRDA Landfill will be necessary once there is no further CCR production at GREC or once the final closure elevations for CCR materials are achieved. Closure of the landfill will be accomplished by closing the CCR waste materials in place. The proposed closure of the GRDA Landfill will be completed according to the following general steps:

- The top of the CCR waste material will be graded and compacted to establish a stable subgrade for the construction of the final cover system. Subgrade elevations shall not exceed the maximum allowable top of waste elevations as determined by the approved closure grading plan.
- A twenty four (24) inch thick compacted barrier layer consisting of clay soil shall be placed over the prepared subgrade.
- A minimum of twelve (12) inches of soil capable of sustaining native plant growth shall be placed over the compacted barrier layer.
- Native plant cover shall be installed through seeding, sprigging or sodding of the site.
- Soil and vegetative cover of the southern and western exterior slopes that was installed earlier shall be inspected and restored, if necessary.

The following sections further describe the applicable closure requirements and procedures.

2.1 Final Cover System [40 CFR 257.102(b)(iii)]

The purpose of the final cover system is to control, minimize or eliminate, to the maximum extent feasible, post-closure infiltration of liquids into the waste thereby minimizing the release of CCR, leachate, or contaminated run-off to the ground or surface waters or to the atmosphere.

Based on the existing DEQ approved landfill Closure Plan, a maximum of 69.5 acres will require final closure as shown in **Figure 1**. If closure is required prior to the utilization of the entire 69.5 acre area, this Plan will be revised and a revised closure design will be developed. It is anticipated that prior to the closure of GRDA Landfill, updated engineered construction drawings and specifications will be prepared for closure construction and submitted to DEQ for approval prior to commencing closure activities.



The final cover system will consist of a clay barrier layer, an erosion layer and vegetative cover. Prior to final cover system construction, the top of the CCR waste material will be graded and compacted to establish a firm subgrade for final cover construction.

The clay barrier layer will consist of at least twenty four (24) inches of earthen material constructed in six (6) inch compacted lifts over the prepared subgrade. The clay barrier layer shall have a hydraulic conductivity no greater than 1.0×10^{-5} cm/sec. It is estimated that 224,253 cubic yards of clay material will be required to construction the clay barrier layer.

The barrier layer soils shall meet the following standards:

1. **Plasticity Index (ASTM D4318):** Plasticity index shall be greater than or equal to 10%.
2. **Liquid Limit (ASTM D4318):** Liquid Limit shall be greater than or equal to 24%.
3. **Percent Fines (ASTM D422):** Percent fines passing the #200 mesh sieve shall be greater than or equal to 30%.
4. **Gravel Amount (ASTM D422):** The amount of gravel (dry-weight percentage retained on the No. 4 sieve) shall be less than or equal to 20%.
5. **Particle Size:** Particle size shall be less than one-inch in diameter.
6. **Water Content:** After the soil is compacted, the water content of the soil shall be equal to or greater than optimum moisture.
7. **Soil Density:** After the soil is compacted, the minimum density of the soil shall be greater than or equal to:
 - a. 95% of the standard proctor density (ASTM D698); or
 - b. 90 % of the modified proctor density (ASTM D1557).

Soil having characteristics within the above limits are workable, good for erosion control and suitable for attaining proper grading. This soil will help minimize liquid infiltration and leachate generation. The soil characteristics for the clay cover soils shall be tested at a minimum rate of one sample per 10,000 cubic yards for conformance.



The erosion layer will be installed above the barrier layer and will consist of at least twelve (12) inches of soil capable of sustaining native plant growth. It is estimated that approximately 112,127 cubic yards of vegetative soil will be required.

A permanent vegetative cover shall be established with plant species that are of equal or superior utility to native vegetation during each season of the year. Permanent vegetation must be effective, long-lasting and capable of self-regeneration and plant succession. Deep-rooted plants, trees, or other similar vegetation should not be allowed to thrive on the final cover.

The final cover gradient on top of the fill, as measured from the center of the fill area to the break in slope between the top and sides of the fill, shall not exceed four (4) percent (25:1) so as to prevent the erosion of cover. Final side slopes of the fill shall not exceed twenty-five (25) percent grade (4:1). Surface contours, including the final grading of completed disposal areas, shall prevent ponding of water and erosion of fill areas.

2.2 Final Certification and Survey

Upon completion of the final closure, a certification of final closure will be prepared by a qualified professional engineer verifying that the closure has been completed in accordance with the Closure Plan, engineering design and applicable regulations. The certification of final closure will include as-built drawings for the final cover system with elevations and thickness of each layer as verified by a professional land surveyor during construction.

2.3 Estimated Maximum Inventory of CCR [40 CFR 257.102(b)(iv)]

Based on historical records of CCR disposal at the landfill and the expected compaction density of these materials, GRDA estimates that approximately 4,297,533 cubic yards of CCRs have been placed within the landfill through December 31, 2015. Based on the information provided by GRDA, the estimated maximum total capacity of the landfill is 7,113,607 cubic yards.

2.4 Estimated Maximum Area of Cover [40 CFR 257.102(b)(v)]

The total permit area of the landfill consists approximately 116 acres, of which only 69.5 acres (3,049,200 square feet) have been developed.



2.5 Schedule of Closure and Required Notifications [40 CFR 257.102(b)(vi)]

Closure of the GRDA Landfill will begin no later than 30 days following the known final receipt of CCR or non-CCR waste. If remaining capacity is available, closure may be delayed for up to two years after the most recent receipt of waste if there is a reasonable likelihood that it will receive additional wastes in the future. Closure of the landfill can also be delayed if CCR will be removed from the landfill for beneficial use purposes.

Based on recent disposal rates, the existing 69.5 acre landfill is expected to reach capacity in 2049. Closure of the GRDA Landfill is anticipated to be completed within 6 months after commencing closure activities. No later than the date that GRDA initiates closure of the landfill, GRDA must prepare a notification of intent to close the landfill. The notification must include the certification by a qualified professional engineer for the design of the final cover system.

Upon completion of closure, GRDA must obtain a certification from a qualified professional engineer verifying that closure has been completed in accordance with the Closure Plan. Within 30 days of completion of closure of the landfill, GRDA must prepare a notification of the closure of the landfill.

Following closure of the landfill, GRDA must record a notation on the deed to the property stating that the land has been used for the disposal of CCR and that its use is restricted under the post-closure care requirements. Within 30 days of recording a notation on the deed to the property, GRDA must prepare a notification stating that the notation has been recorded. The notification is considered complete when it has been placed in the facility's operating records.

A tentative schedule of closure activities are provided in **Table 1** below based on the timeline of required activities discussed in this Closure Plan. As shown in Table 1, the closure of the GRDA Landfill is expected to be complete by July 31, 2050.



TABLE 1: GRDA Landfill Tentative Closure Schedule

TASK Description	Anticipated Start Date	Anticipated Completion Date
<i>Landfill Operation</i>		
CCR Disposal	1982	12/31/2049
<i>Design / Bidding</i>		
Preparation Closure Design Drawings and Specifications	3/31/2049	9/30/2049
Obtain a Qualified Contractor to Perform Closure	9/30/2049	12/31/2049
<i>Construction</i>		
Place a <i>Notification of Intent to Close</i> the Landfill in the Operating Record	1/31/2050	1/31/2050
Send <i>Notification of Intent to Close</i> to DEQ and Post Notification to the Internet Website.	1/31/2050	1/31/2050
Perform Closure Construction Activities	1/31/2050	7/31/2050
<i>Post-Construction</i>		
Certification of final closure by Professional Engineer	8/1/2050	8/31/2050
Place a Notification of Final Closure Completion in the Operating Record	8/1/2050	8/31/2050
Send Notification of availability of Closure Completion documentation to DEQ and publish to the Internet Website	8/1/2050	8/31/2050
Record a Notation of the landfill closure on the Deed of the Property	8/1/2050	8/31/2050
Place a Notification of the Deed Notation in the Operating Record	8/1/2050	8/31/2050
Send Notification of availability of Deed Notation to DEQ and publish Deed Notation to the Internet Website	8/1/2050	8/31/2050
Post-Closure Care Period	9/1/2050	9/1/2080



2.6 Closure Cost Estimates and Financial Assurance

GRDA will continue to provide DEQ with annual closure cost estimate updates and satisfy financial assurance obligations required by the facility permit.

3.0 PLAN AMENDMENTS AND REVISIONS

In accordance with 40 CFR 257.102(b)(3), GRDA may amend this written Closure Plan at any time provided the revised plan is placed in the facility's operating record as required by Part 257.105(g)(3). GRDA is required to amend this written Closure Plan whenever there is a change in conditions that would substantially affect the written plan in effect or if unanticipated events before or after the commencement of closure activities necessitates a revision.

GRDA must amend this Plan at least 60 days prior to a planned change in the operation of the facility or no later than 60 days after an unanticipated event requires the need to revise the Plan. If a written closure plan is revised after closure activities have commenced for the landfill, GRDA must amend the written closure plan no later than 30 days following the triggering event.

4.0 RECORDKEEPING REQUIREMENTS

In accordance with 40 CFR 257.105, GRDA must maintain this Closure Plan in the facility operating record.

5.0 OTHER NOTIFICATION REQUIREMENTS

In accordance with 40 CFR 257.106(g), the DEQ Land Protection Division must be notified when this document or any subsequent amendments or revisions to this document are placed in the operating record and on the publicly accessible internet site.

6.0 CCR WEBSITE REQUIREMENTS

In accordance with 40 CFR 257.107, GRDA must maintain this Closure Plan on the corporate "CCR Rule Compliance Data and Information" webpage.



7.0 REFERENCES

Holway-United, *Grand River Dam Authority 490-MW Coal-Fired Generating Station Ash Disposal Site Permit Application, Chouteau, Oklahoma.* August 22, 1979.

Oklahoma State Department of Health (OSDH), *Permit for a Coal Ash Disposal Site.* January 13, 1981.

Oklahoma Department of Environmental Quality (DEQ), *Permit Modification to add an additional Solid Waste Stream, Grand River Dam Authority, Mayes County, Permit 3549012.* February 20, 2015.

United States Environmental Protection Agency (USEPA), *40 CFR Part 257, Subpart D.* April 17, 2015.

Grand River Dam Authority (GRDA), *Coal Combustion Residual Fugitive Dust Control Plan for Grand River Energy Center.* October 2015



RECEIVED

MAR 15 2017

LAND PROTECTION DIVISION
DEPARTMENT OF ENVIRONMENTAL QUALITY

POST-CLOSURE PLAN

FOR

GRAND RIVER DAM AUTHORITY LANDFILL

GRAND RIVER ENERGY CENTER

MAYES COUNTY, OKLAHOMA

SOLID WASTE PERMIT NO. 3549012

PREPARED FOR:

GRDA

Grand River Dam Authority

GRAND RIVER DAM AUTHORITY

VINITA, OKLAHOMA

OCTOBER 11, 2016

A&M PROJECT NO. 1986-018

PREPARED BY:

A&M ENGINEERING AND ENVIRONMENTAL SERVICES, INC.

10010 E. 16TH STREET

TULSA, OKLAHOMA 74128-4813

PHONE (918) 665-6575 & FAX (918) 665-6576

EMAIL: aandm@aandmengineering.com

POST-CLOSURE PLAN
GRAND RIVER DAM AUTHORITY LANDFILL
GRAND RIVER ENERGY CENTER
MAYES COUNTY, OKLAHOMA

TABLE OF CONTENTS

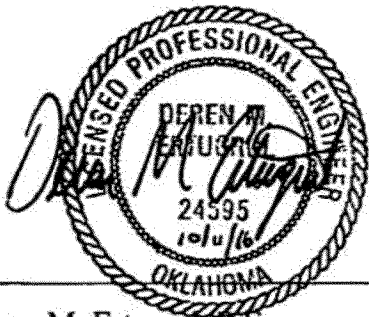
<u>SECTION</u>	<u>PAGE</u>
CERTIFICATION STATEMENT.....	ii
1.0 INTRODUCTION	1
2.0 POST-CLOSURE PLAN [40 CFR 257.104(d)].....	1
2.1 Monitoring and Maintenance Activities [40 CFR 257.104(d)(1)(i)]	2
2.2 Post-Closure Contact Person [40 CFR 257.104(d)(1)(ii)]	2
2.3 Post-Closure Site Use [40 CFR 257.104(d)(1)(iii)]	3
2.4 Post-Closure Cost Estimates and Financial Assurance	3
3.0 PLAN AMENDMENTS AND REVISIONS [40 CFR 257.104(d)(3)].....	3
4.0 RECORDKEEPING REQUIREMENTS	3
5.0 NOTIFICATION REQUIREMENTS	3
6.0 CCR WEBSITE REQUIREMENTS	4
7.0 REFERENCES	5



CERTIFICATION STATEMENT

I certify that this Post-Closure Plan was prepared under my direction or supervision in accordance with good engineering practice and the requirements of 40 CFR §257.104 for the GRDA Landfill located within the Grand River Energy Center complex in Mayes County, Oklahoma. Based on the information reviewed, this report is to the best of my knowledge and belief, true, accurate and complete.

A&M ENGINEERING AND ENVIRONMENTAL SERVICES, INC.



Deren M. Ertugrul, P.E.

Oklahoma Registration No. 24595

10/11/16

Date



**POST-CLOSURE PLAN
GRAND RIVER DAM AUTHORITY LANDFILL
GRAND RIVER ENERGY CENTER
MAYES COUNTY, OKLAHOMA**

1.0 INTRODUCTION

The Grand River Dam Authority (GRDA) owns and operates the Grand River Energy Center (GREC) electric generating station located approximately three (3) miles east of the City of Chouteau in Mayes County, Oklahoma. Two (2) coal fired boilers are operated at GREC which produce Coal Combustion Residuals (CCRs) consisting of fly ash and bottom ash. Fly ash comprises greater than 80% of CCRs generated at the facility and is largely sold for beneficial use purposes. Excess fly ash and bottom ash is disposed at a permitted coal ash landfill, herein referred to as the GRDA Landfill, located within the GREC complex.

The GRDA Landfill is permitted by the Oklahoma Department of Environmental Quality (DEQ) as a Non-Hazardous Industrial Waste Landfill that is allowed to accept fly ash, bottom ash and spent powdered activated carbon used to control flue gas emissions, generated at the GREC (DEQ, 2015). The GRDA Landfill is situated south of the coal fired boiler units within the GREC complex and has been in operation since 1982. The total landfill permit area consists of approximately 116 acres, of which only 69.5 acres is available for use. 47 acres have been utilized for CCR disposal to date.

This written Post-Closure Plan has been prepared to satisfy the requirements of 40 CFR 257.102(d) which requires existing CCR landfills to prepare *"a written post-closure plan that includes, at a minimum, the information specified in paragraphs (d)(1)(i) through (iii) of this section."*

2.0 POST-CLOSURE PLAN [40 CFR 257.104(d)]

Following closure of the GRDA Landfill, post-closure care must be provided for 30 years.

During the post-closure care period, the landfill will be monitored and maintained as described in the following sections.



2.1 Monitoring and Maintenance Activities [40 CFR 257.104(d)(1)(i)]

During the post-closure care period, access to the site will be controlled by the facility perimeter fence, access gates and regular facility security. Only authorized personnel will be allowed entry into the landfill area.

GRDA will maintain the integrity and effectiveness of the final cover system by making repairs to the final cover as necessary to correct the effects of settlement, subsidence, erosion, or other events and preventing run-on and run-off from eroding or otherwise damaging the final cover. All areas of erosion, settlement and subsidence will be repaired with suitable fill soil and re-vegetated. Surface water controls will be maintained as necessary to ensure proper site drainage. Vegetation will be mowed at least annually to control the growth of unwanted vegetation that may damage the integrity of the final cover system. Regular inspections of the landfill, including cover areas, slopes, surface water controls and ancillary features will be performed, at least quarterly, in order to identify any relevant maintenance items that require attention.

GRDA will continue to maintain the groundwater monitoring system and implement the groundwater monitoring program in accordance with the landfill Sampling and Analysis Plan and 40 CFR 257.90 through 257.98.

2.2 Post-Closure Contact Person [40 CFR 257.104(d)(1)(ii)]

The contact information for the GRDA Landfill during the post-closure care period will be as follows:

Grand River Dam Authority
Attn: Superintendent of Environmental Compliance
P.O. Box 70
Langley, Oklahoma 74350-0070

The name, address and telephone number of the post-closure contact person will be updated as necessary upon notice of closure.



2.3 Post-Closure Site Use [40 CFR 257.104(d)(1)(iii)]

The landfill will remain part of the GREC complex and will be maintained regularly. There will be no use of the landfill during or after the post-closure care period that will damage the integrity of the final cover system.

2.4 Post-Closure Cost Estimates and Financial Assurance

GRDA will continue to provide DEQ with annual post-closure cost estimate updates and satisfy financial assurance obligations required by the facility permit.

3.0 PLAN AMENDMENTS AND REVISIONS [40 CFR 257.104(d)(3)]

In accordance with 40 CFR 257.104(d)(3), GRDA may amend this written Post-Closure Plan at any time provided the revised plan is placed in the facility's operating record as required by Part 257.105(g)(3). GRDA is required to amend this written Post-Closure Plan whenever there is a change in conditions that would substantially affect the written plan in effect or if unanticipated events before or after the commencement of closure activities necessitates a revision. GRDA must amend this Plan at least 60 days prior to a planned change in the operation of the facility or no later than 60 days after an unanticipated event requires the need to revise the Plan. If a written Post-Closure Plan is revised after post-closure activities have commenced, GRDA must amend the written Post-Closure Plan no later than 30 days following the triggering event.

4.0 RECORDKEEPING REQUIREMENTS

In accordance with 40 CFR 257.105, GRDA must maintain this Post-Closure Plan in the facility operating record.

5.0 NOTIFICATION REQUIREMENTS

In accordance with 40 CFR 257.106(g), the DEQ Land Protection Division must be notified when this document or any subsequent amendments or revisions to this document are placed in the operating record and on the publicly accessible internet site.



No later than 60 days following the completion of the post-closure care period, GRDA will prepare a notification verifying that the post-closure care has been completed. The notification must include the certification by a qualified professional engineer verifying that post-closure care has been completed in accordance with the post-closure plan and 40 CFR 257.104.

6.0 CCR WEBSITE REQUIREMENTS

In accordance with 40 CFR 257.107, GRDA must maintain this Closure Plan on the corporate "CCR Rule Compliance Data and Information" webpage.



7.0 REFERENCES

Holway-United, *Grand River Dam Authority 490-MW Coal-Fired Generating Station Ash Disposal Site Permit Application, Chouteau, Oklahoma.* August 22, 1979.

Oklahoma State Department of Health (OSDH), *Permit for a Coal Ash Disposal Site.* January 13, 1981.

Oklahoma Department of Environmental Quality (DEQ), *Permit Modification to add an additional Solid Waste Stream, Grand River Dam Authority, Mayes County, Permit 3549012.* February 20, 2015.

United States Environmental Protection Agency (USEPA), *40 CFR Part 257, Subpart D.* April 17, 2015.

Grand River Dam Authority (GRDA), *Coal Combustion Residual Fugitive Dust Control Plan for Grand River Energy Center.* October 2015



RECEIVED

MAR 15 2017

LAND PROTECTION DIVISION
DEPARTMENT OF ENVIRONMENTAL QUALITY

INITIAL RUN-ON AND RUN-OFF CONTROL PLAN

FOR

GRAND RIVER DAM AUTHORITY LANDFILL

GRAND RIVER ENERGY CENTER

MAYES COUNTY, OKLAHOMA

SOLID WASTE PERMIT NO. 3549012

PREPARED FOR:



Grand River Dam Authority

GRAND RIVER DAM AUTHORITY

VINITA, OKLAHOMA

OCTOBER 11, 2016

A&M PROJECT NO. 1986-016

PREPARED BY:

A&M ENGINEERING AND ENVIRONMENTAL SERVICES, INC.

10010 E. 16TH STREET

TULSA, OKLAHOMA 74128-4813

PHONE (918) 665-6575 & FAX (918) 665-6576

EMAIL: aandm@aandmengineering.com

**INITIAL RUN-ON AND RUN-OFF CONTROL PLAN
GRAND RIVER DAM AUTHORITY LANDFILL
GRAND RIVER ENERGY CENTER
MAYES COUNTY, OKLAHOMA**

TABLE OF CONTENTS

<u>SECTION</u>	<u>PAGE</u>
CERTIFICATION STATEMENT.....	iii
1.0 INTRODUCTION	1
2.0 LANDFILL INFORMATION	2
2.1 Design and Construction History	2
2.2 Operational Methods	3
3.0 RUN-ON CONTROLS	4
4.0 RUN-OFF CONTROLS	4
5.0 PLAN AMENDMENTS	4
6.0 PLAN REVISIONS	5
7.0 RECORDKEEPING REQUIREMENTS	5
8.0 NOTIFICATION REQUIREMENTS	5
9.0 CCR WEBSITE REQUIREMENTS	5
10.0 REFERENCES	6

FIGURES

- FIGURE 1 Site Map
FIGURE 2 Drainage Map



APPENDICES

APPENDIX A Drainage Calculations

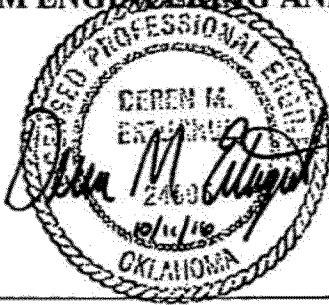


A & M Engineering
Project No. 1986-016

CERTIFICATION STATEMENT

I certify that this Run-on and Run-off Control Plan was prepared under my direction or supervision in accordance 40 CFR §257.81(c) for the GRDA Landfill located within the Grand River Energy Center complex in Mayes County, Oklahoma. Based on the information reviewed this report is to the best of my knowledge and belief, true, accurate and complete.

A&M ENGINEERING AND ENVIRONMENTAL SERVICES, INC.



Deren M. Ertugrul, P.E.

Oklahoma Registration No. 24595

10/11/2016

Date



**INITIAL RUN-ON AND RUN-OFF CONTROL PLAN
GRAND RIVER DAM AUTHORITY LANDFILL
GRAND RIVER ENERGY CENTER
MAYES COUNTY, OKLAHOMA**

1.0 INTRODUCTION

The Grand River Dam Authority (GRDA) owns and operates the Grand River Energy Center (GREC) electric generating facility located approximately three (3) miles east of the City of Chouteau in Mayes County, Oklahoma. Two (2) coal fired boilers are operated at GREC which produce Coal Combustion Residuals (CCRs) consisting of fly ash and bottom ash. Fly ash comprises greater than 80% of CCRs generated at the facility and is largely sold for beneficial use purposes. Excess fly ash and bottom ash is disposed within a permitted coal ash landfill, herein referred to as the GRDA Landfill, located within the GREC complex.

On April 17, 2015, the United States Environmental Protection Agency (USEPA) published a final rule for the Disposal of CCRs from Electric Utilities. This new rule regulates the disposal of CCRs under 40 CFR Parts 257 and 261. The rule applies both to new and existing CCR landfills and surface impoundments at coal burning electric utility sites.

40 CFR 257.81(c)(1) requires existing CCR landfill facilities to prepare *“initial and periodic run-on and run-off control system plans for the CCR unit according to the timeframes specified in paragraphs(c)(3) and (4) of this section. These plans must document how the run-on and run-off control systems have been designed and constructed to meet the applicable requirements of this section. Each plan must be supported by appropriate engineering calculations. The owner or operator has completed the initial run-on and run-off control system plan when the plan has been placed in the facility's operating record as required by §257.105(g)(3).”*

This Run-On and Run-Off Control Plan has been prepared to satisfy the requirements of 40 CFR 257.81(c).



2.0 LANDFILL INFORMATION

The GRDA Landfill is permitted by the Oklahoma Department of Environmental Quality (DEQ) as a Non-Hazardous Industrial Waste Landfill that is allowed to accept fly ash, bottom ash and spent powdered activated carbon used to control flue gas emissions, generated at the GREC (DEQ, 2015). The GRDA Landfill is situated south of the coal fired boiler units within the GREC complex and has been in operation since 1981. The total landfill permit area consists of approximately 116 acres, of which only 47 acres have been utilized for CCR disposal and remains active to date.

2.1 Design and Construction History

Prior to permit issuance and construction, it was established through the performance of geotechnical investigations and testing that the landfill site was underlain by an impermeable clay layer that ranged in thickness from 11 to 23 feet across the site (Holway-United, 1979). The landfill was initially established by constructing a perimeter dike around a 70 acre portion of the permitted landfill area as shown in **Figure 1**.

The perimeter dikes were constructed of native clay soils from the site. Approved grading plans for the site indicate that the exterior slopes of the perimeter dike was designed to range between 3 feet Horizontal to 1 foot Vertical (3:1) and 2.5:1 while the interior slopes were designed to range between 2:1 and 2.5:1 (Holway-United, 1979).

The landfill was designed so that all surface water drainage is routed around and/or away from the landfill area. Current site drainage patterns are shown in **Figure 2**. Minimal watershed areas impact the outer perimeter of the landfill as the general site topography promotes drainage away from the perimeter of the landfill, especially on the south, east and west sides of the landfill. The majority of surface water on the north side of the landfill naturally drains around the landfill in a direction parallel to the perimeter dike to natural drainages within the site. Potential run-on is controlled primarily by the perimeter landfill dike which ranges in height from 3 to 30 feet above the surrounding topography. On the north and east sides of the landfill, drainage ditches also help convey potential run-on flow around the perimeter dike of the landfill.



On the western and southern sides of the landfill diversion channels are not required because the topography promotes drainage away from the perimeter of the landfill and directly into a series of permitted Class III industrial wastewater treatment impoundments regulated by an Oklahoma Pollutant Discharge Elimination System (OPDES) permit. The industrial wastewater system consists of eleven (11) process water and storm water retention/treatment basins around the western and southern perimeter of the landfill. These surface impoundments provide a total holding capacity of 1,371,521,000 gallons as stated in the facility OPDES permit and receive process water; cooling tower water; and storm water run-off from the landfill, coal pile, and the operational areas of the plant.

2.2 Operational Methods

General operational activities employed at the GRDA Landfill include the transportation and placement of CCRs in the landfill; general maintenance of the landfill; and installation of soil cover as necessary.

CCR material to be disposed at the landfill is transferred from storage silos to transport vehicles utilizing dry loading methods. During loading, fly ash is moisture conditioned for the purposes of fugitive dust control and compaction in the landfill (GRDA, 2015). Bottom ash has a granular/gravel texture and is also dampened with water for fugitive dust control purposes prior to loading (GRDA, 2015). Once loaded, the transport vehicles then convey CCRs to the landfill for final disposal. At the landfill, water trucks are used to minimize fugitive dust as necessary. Application of daily soil cover is not generally necessary for the conditions at this landfill.

As design top of waste elevations are achieved, GRDA has applied either final or intermediate soil cover to the exterior landfill slopes and has established vegetation in order to minimize water infiltration into the landfill and reduce erosion and transport of soils and/or CCR materials from the landfill. Side slopes are regularly mowed, monitored and maintained. Precipitation run-off from the exterior slopes is collected within the wastewater impoundments around the landfill. Precipitation run-off from the active landfill area is collected within the permitted landfill area and drained into the industrial wastewater treatment system.



3.0 RUN-ON CONTROLS

40 CFR 257.81(a)(1) requires existing CCR landfill facilities to design, construct, operate and maintain a run-on control system to prevent the flow onto the active portion of the CCR unit during the peak discharge from a 24-hour, 25-year storm event. In order to verify that the landfill complies with the run-on control system requirements, drainage calculations were performed assuming a 25-year, 24-hour storm precipitation of 7.1 inches, based on the current National Resource Conservation Service (NRCS) storm database. Drainage calculations are provided in **Appendix A**. The perimeter dike prevents any potential peak run-on flow from a 24-hour, 25-year storm event from entering the active portion of the landfill.

4.0 RUN-OFF CONTROLS

40 CFR 257.81(a)(2) requires existing CCR landfill facilities to design, construct, operate and maintain a run-off control system from the active portion of the CCR unit to collect and control at least the water volume resulting from a 24-hour, 25-year storm. Run-off from the active portions of the CCR unit is maintained within the permitted landfill area then flows to the permitted wastewater treatment impoundments on the western and southern sides of the landfill. Run-off from the areas of CCR unit where final or intermediate cover is already in place also flows into wastewater treatment impoundments either directly or through perimeter drainage swales. The wastewater treatment system handles process water and storm water from the operational areas of the plan, including the landfill, and is regulated by an OPDES permit.

In accordance with 40 CFR 257.81(b), run-off is managed in a manner consistent with the surface water requirements of 40 CFR 257.3-3.

5.0 PLAN AMENDMENTS

In accordance with 40 CFR 257.81(c)(2), GRDA may amend this written Run-On and Run-Off Control Plan at any time provided the revised plan is placed in the facility's operating record as required by Part 257.105(g)(3). GRDA is required to amend this written Run-On and Run-Off



Control Plan whenever there is a change in conditions that would substantially affect the written plan in effect.

6.0 PLAN REVISIONS

In accordance with 40 CFR 257.81(c)(4), GRDA must prepare periodic Run-On and Run-Off Control Plan at least once every five (5) years. The deadline for completion of the first periodic Run-On and Run-Off Control Plan is five (5) years from the date of this initial Plan.

7.0 RECORDKEEPING REQUIREMENTS

In accordance with 40 CFR 257.105, GRDA must maintain this Run-On and Run-Off Control Plan in the facility operating record. Unless specified otherwise, each file must be retained for at least five (5) years following the date of each occurrence, measurement, maintenance, corrective action, report, record, or study.

8.0 NOTIFICATION REQUIREMENTS

In accordance with 40 CFR 257.106(g), the DEQ Land Protection Division must be notified when this document or any subsequent amendments or revisions to this document are placed in the operating record and on the publicly accessible internet site.

9.0 CCR WEBSITE REQUIREMENTS

In accordance with 40 CFR 257.107, GRDA must maintain this Run-On and Run-Off Control Plan on the corporate "CCR Rule Compliance Data and Information" webpage. Unless otherwise required, the information required to be posted to the CCR Website must be made available to the public for at least five (5) years following the date on which the information was first posted.



10.0 REFERENCES

Holway-United, *Grand River Dam Authority 490-MW Coal-Fired Generating Station Ash Disposal Site Permit Application, Chouteau, Oklahoma.* August 22, 1979.

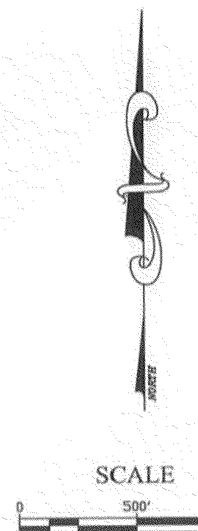
Oklahoma State Department of Health (OSDH), *Permit for a Coal Ash Disposal Site.* January 13, 1981.

Oklahoma Department of Environmental Quality (DEQ), *Permit Modification to add an additional Solid Waste Stream, Grand River Dam Authority, Mayes County, Permit 3549012.* February 20, 2015.

United States Environmental Protection Agency (USEPA), *40 CFR Part 257, Subpart D.* April 17, 2015.

Grand River Dam Authority (GRDA), *Coal Combustion Residual Fugitive Dust Control Plan for Grand River Energy Center.* October 2015





DJR 4/13/06

GENERAL NOTES

2ED BY GRDA.
ROVIDED BY GOOGLE EARTH, DATED JUNE 10, 2013.

REVISIONS

NO.	DESCRIPTION	BY	CHECKED	DATE	NO.	DESCRIPTION	BY	CHECKED	DATE



A & M ENGINEERING AND
ENVIRONMENTAL SERVICES, INC.

ENGINEERING - ENVIRONMENTAL - CONSTRUCTION

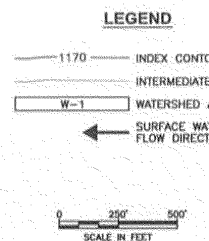
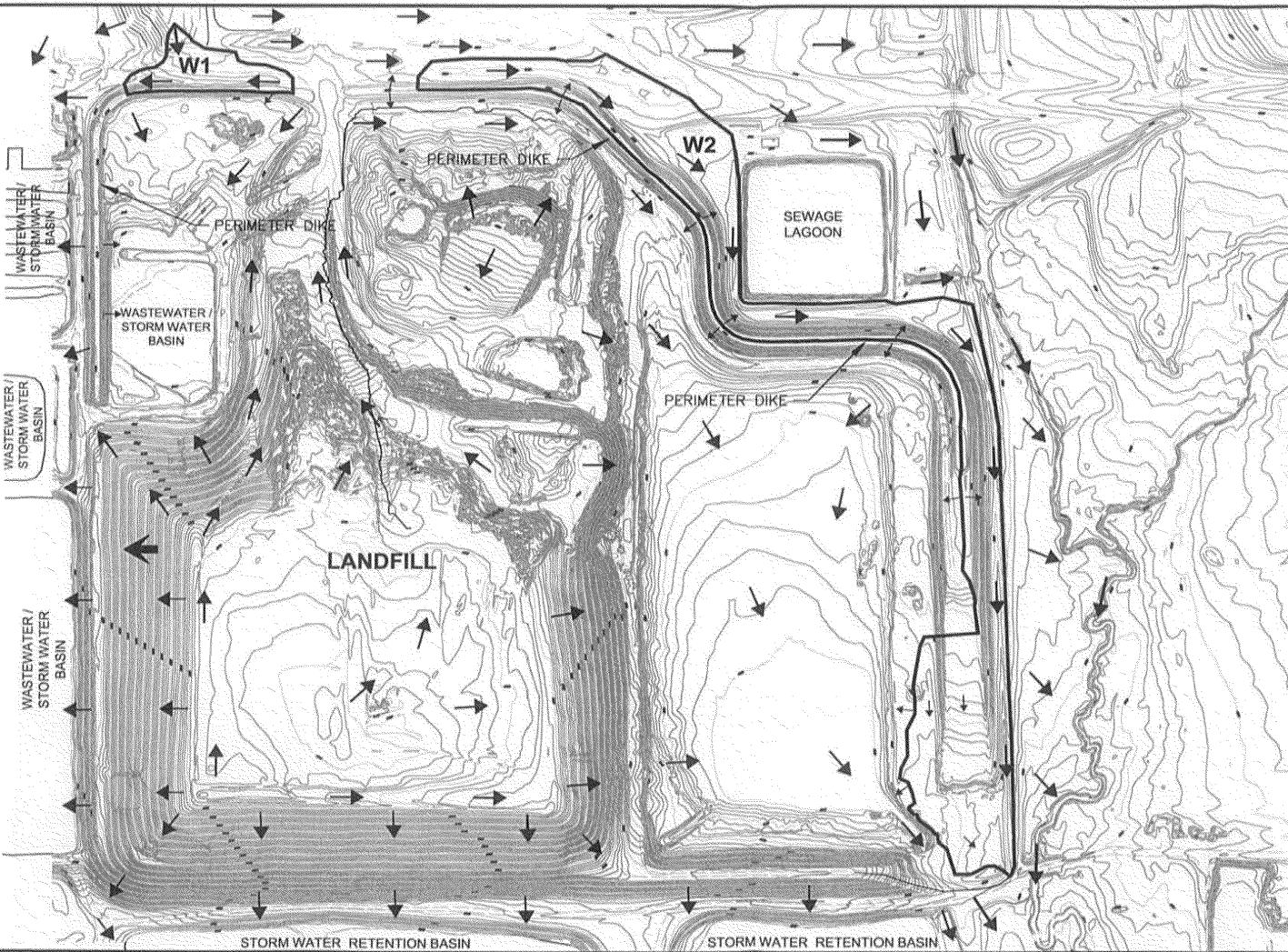
DATE	DATE	CHECKED BY	DATE	DATE	DATE	DATE	DATE	DATE	DATE
10/10/2018	10/10/2018	10/10/2018	10/10/2018	10/10/2018	10/10/2018	10/10/2018	10/10/2018	10/10/2018	10/10/2018

SITE MAP

GRAND RIVER DAM AUTHORITY
CHOUTEAU, OKLAHOMA

PROJECT NUMBER 1500-010

ED_001836_00000076-00032



GENERAL NOTES MAP BASED ON AERIAL SURVEY PERFORMED BY AERIAL DATA SERVICES, INC. ON MARCH 13, 2014 AND A SUPPLEMENTAL SURVEY OF THE AREA NORTHWEST OF THE LANDFILL PERFORMED BY A&M ENGINEERING ON OCTOBER 6, 2016.				REVISIONS				 A & M ENGINEERING AND ENVIRONMENTAL SERVICES, INC. ENGINEERING • ENVIRONMENTAL • CONSTRUCTION		SITE DRAINAGE MAP GRAND RIVER DAM AUTHORITY CHOCTEAU, OKLAHOMA								
NO.	DESCRIPTION	BY	CHECKED	DATE	NO.	DESCRIPTION	BY	CHECKED	DATE	DRAWN	CHECKED BY	MATERIALS BY	ENGINEER	APPROVED BY	SCALE	PROJECT NUMBER	DRAWING NUMBER	
										CLM	DME	DME	DME	DME	DME	NOTED	1666-D18	
										DATE: 10/6/2016	DATE: 10/10/2016	DATE:	DATE: 10/10/2016	DATE: 10/10/2016				

ED_001836_00000076-00034



**A & M ENGINEERING AND
ENVIRONMENTAL SERVICES, INC.**

10010 East 16th Street
Tulsa, Oklahoma 74128-4813
Tel: (918) 665-6575 • Fax: (918) 665-6576

SHEET NO. 1 OF 18

PROJECT TITLE GRDA LANDFILL

CALCULATED BY DME DATE 10/10/16

SUBJECT DRAINAGE CALCS JOB NO. 1668-016

REQUIRED: DETERMINE WHETHER PERIMETER DIKE AND DRAINAGE DITCHES CAN PREVENT THE FLOW OF SURFACE WATER ONTO THE ACTIVE PORTION OF THE LANDFILL DURING A 24 HOUR, 25-YEAR STORM.

APPROACH: ① DETERMINE WATERSHED AREAS CONTRIBUTING TO SURFACE WATER FLOW TOWARDS THE LANDFILL PERIMETER DIKE.

② USE THE TR-55 METHOD TO DETERMINE TIME OF CONCENTRATION AND PEAK FLOW DURING A 24-HR, 25-YR STORM.

③ CALCULATE THE DEPTH AND VELOCITY OF PEAK FLOW FOR PERIMETER DIKE AND DITCHES.

ASSUMPTIONS: ① HYDROLOGIC SOIL GROUP C&D BASED ON NRCS SOIL SURVEY

C: SANDY CLAY LOAM

D: CLAY LOAM, SILTY CLAY LOAM, SANDY CLAY, SILTY CLAY, OR CLAY

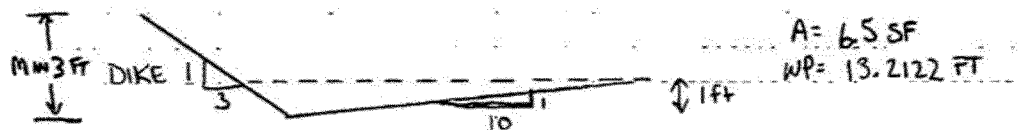
② HYDROLOGIC CONDITION OF SOIL IS FAIR

③ MANNINGS NO. FOR OVERLAND FLOW IS 0.15 FOR SHORT GRASS-RANGE

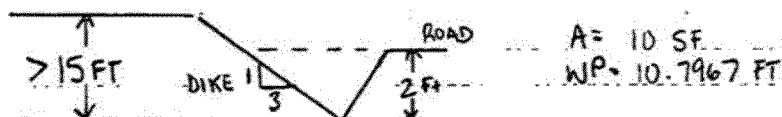
④ MANNINGS NO. FOR CHANNEL FLOW IS 0.03 FOR ROUGH CHANNEL WITH GRASS

⑤ CN NUMBER OF 82 IS USED AS AN AVERAGE BETWEEN FAIR CONDITION C&D SOILS

⑥ PERIMETER DIKE DRAINAGE CROSS SECTION



⑦ EASTERN DRAINAGE DITCH





**A & M ENGINEERING AND
ENVIRONMENTAL SERVICES, INC.**

10010 East 16th Street
Tulsa, Oklahoma 74128-4813
Tel: (918) 665-6575 • Fax: (918) 665-6576

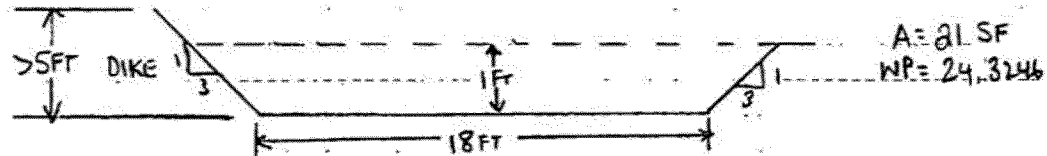
SHEET NO. 2 OF 18

PROJECT TITLE GROA LANDFILL

CALCULATED BY DME DATE 10/10/16

SUBJECT DEGNAGE CALL JOB NO. 1668-016

ASSUMPTIONS: ⑧ NORTH EAST DRAINAGE CHANNEL



⑨ NRCS STORM DATABASE FOR MAYES COUNTY, OK UTILIZED FOR LOCAL
RAINFALL DATA

CALCULATIONS: ① WATERSHED AREAS BELOW DETERMINED BASED ON 2014 FLOWER SURVEY

W-1: 0.74 ACRE

W-2: 8.27 ACRE

② I.R.-SS. PEAK FLOW OUTPUT SHEETS ATTACHED

③ PEAK FLOW DEPTH AND VELOCITY CALCULATIONS ATTACHED

WinTR-55 Current Data Description

--- Identification Data ---

User: DME Date: 10/10/2016
 Project: GRDA Units: English
 SubTitle: RUN-ON W1 Areal Units: Acres
 State: Oklahoma
 County: Mayes
 Filename: Z:\1 - Engineering & Environmental\Active\1986 - GRDA\016 - Run-on Run-off Plan\W1.w55

--- Sub-Area Data ---

Name	Description	Reach	Area(ac)	RCN	Tc
W1		Outlet	0.74	82	.106

Total area: .74 (ac)

--- Storm Data ---

Rainfall Depth by Rainfall Return Period

2-Yr (in)	5-Yr (in)	10-Yr (in)	25-Yr (in)	50-Yr (in)	100-Yr (in)	1-Yr (in)
4.0	5.2	6.1	7.1	8.0	8.9	3.2

Storm Data Source: User-provided custom storm data
 Rainfall Distribution Type: Type II
 Dimensionless Unit Hydrograph: <standard>

DME

GRDA
RUN-ON W1
Mayes County, Oklahoma

Storm Data

Rainfall Depth by Rainfall Return Period

2-Yr (in)	5-Yr (in)	10-Yr (in)	25-Yr (in)	50-Yr (in)	100-Yr (in)	1-Yr (in)
4.0	5.2	6.1	7.1	8.0	8.9	3.2

Storm Data Source: User-provided custom storm data
Rainfall Distribution Type: Type II
Dimensionless Unit Hydrograph: <standard>

DME

GRDA
RUN-ON W1
Mayes County, Oklahoma

Watershed Peak Table

Sub-Area or Reach Identifier	Peak Flow by Rainfall Return Period 25-Yr (cfs)
------------------------------------	---

SUBAREAS

W1	5.55
----	------

REACHES

OUTLET	5.55
--------	------

DME

GRDA
RUN-ON W1
Mayes County, Oklahoma

Hydrograph Peak/Peak Time Table

Sub-Area or Reach Identifier	Peak Flow and Peak Time (hr) by Rainfall Return Period 25-Yr (cfs) (hr)
------------------------------------	--

SUBAREAS

W1	5.55 11.94
----	---------------

REACHES

OUTLET	5.55
--------	------

DME

GRDA
RUN-ON W1
Mayes County, Oklahoma

Sub-Area Summary Table

Sub-Area Identifier	Drainage Area (ac)	Time of Concentration (hr)	Curve Number	Receiving Reach	Sub-Area Description
W1	.74	0.106	82	Outlet	

Total Area: .74 (ac)

DME

GRDA
RUN-ON W1
Mayes County, Oklahoma

Sub-Area Time of Concentration Details

Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Velocity (ft/sec)	Travel Time (hr)
W1							
SHEET	30	0.0102	0.150				0.073
CHANNEL	365	0.0102	0.030	4.00	8.26	3.072	0.033
Time of Concentration							<u>.106</u>

DME

GRDA
RUN-ON W1
Mayes County, Oklahoma

Sub-Area Land Use and Curve Number Details

Sub-Area Identifier	Land Use	Hydrologic Soil Group	Sub-Area Area (ac)	Curve Number
W1	Open space; grass cover 50% to 75% (fair)	C	.37	79
	Open space; grass cover 50% to 75% (fair)	D	.37	84
	Total Area / Weighted Curve Number		.74	82
			==	==

Worksheet Worksheet for Triangular Channel

Project Description	
Worksheet	North Dike
Flow Element	Triangular Char
Method	Manning's Form
Solve For	Channel Depth

Input Data	
Mannings Coeff	0.030
Slope	010120 ft/ft
Left Side Slope	3.00 H : V
Right Side Slope	10.00 H : V
Discharge	5.55 cfs

Results	
Depth	0.62 ft
Flow Area	2.5 ft ²
Wetted Perim	8.14 ft
Top Width	8.01 ft
Critical Depth	0.54 ft
Critical Slope	0.020752 ft/ft
Velocity	2.25 ft/s
Velocity Head	0.08 ft
Specific Energ	0.69 ft
Froude Numb	0.71
Flow Type	Subcritical

← FLOW DEPTH < HEIGHT OF DIKE - OK

WinTR-55 Current Data Description

--- Identification Data ---

User: DME Date: 10/10/2016
 Project: GRDA Units: English
 SubTitle: W2 Areal Units: Acres
 State: Oklahoma
 County: Mayes
 Filename: Z:\1 - Engineering & Environmental\Active\1986 - GRDA\016 - Run-on Run-off Plan\W2.w55

--- Sub-Area Data ---

Name	Description	Reach	Area(ac)	RCN	Tc
W2		Outlet	8.27	82	.501

Total area: 8.27 (ac)

--- Storm Data ---

Rainfall Depth by Rainfall Return Period

2-Yr (in)	5-Yr (in)	10-Yr (in)	25-Yr (in)	50-Yr (in)	100-Yr (in)	1-Yr (in)
4.0	5.2	6.1	7.1	8.0	8.9	3.2

Storm Data Source: Mayes County, OK (NRCS)
 Rainfall Distribution Type: Type II
 Dimensionless Unit Hydrograph: <standard>

DME

GRDA
W2
Mayes County, Oklahoma

Storm Data

Rainfall Depth by Rainfall Return Period

2-Yr (in)	5-Yr (in)	10-Yr (in)	25-Yr (in)	50-Yr (in)	100-Yr (in)	1-Yr (in)
4.0	5.2	6.1	7.1	8.0	8.9	3.2

Storm Data Source: Mayes County, OK (NRCS)
Rainfall Distribution Type: Type II
Dimensionless Unit Hydrograph: <standard>

DME

GRDA
W2
Mayes County, Oklahoma
Watershed Peak Table

Sub-Area or Reach Identifier	Peak Flow by Rainfall Return Period 25-Yr (cfs)

SUBAREAS	
W2	36.26
REACHES	
OUTLET	36.26

DME

GRDA

W2

Mayes County, Oklahoma

Hydrograph Peak/Peak Time Table

Sub-Area or Reach Identifier	Peak Flow and Peak Time (hr) by Rainfall Return Period 25-Yr (cfs) (hr)
------------------------------------	--

SUBAREAS

W2	36.26 12.17
----	----------------

REACHES

OUTLET	36.26
--------	-------

DME

GRDA

W2

Mayes County, Oklahoma

Sub-Area Summary Table

Sub-Area Identifier	Drainage Area (ac)	Time of Concentration (hr)	Curve Number	Receiving Reach	Sub-Area Description
W2	8.27	0.501	82	Outlet	

Total Area: 8.27 (ac)

DME

GRDA

W2

Mayes County, Oklahoma

Sub-Area Time of Concentration Details

Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Velocity (ft/sec)	Travel Time (hr)
W2							
SHEET	100	0.0031	0.150				0.308
CHANNEL	1542	0.0078	0.030	21.00	24.32	3.966	0.108
CHANNEL	1273	0.0078	0.030	10.00	10.79	4.160	0.085

Time of Concentration .501

DME

GRDA

W2

Mayes County, Oklahoma

Sub-Area Land Use and Curve Number Details

Sub-Area Identifier	Land Use	Hydrologic Soil Group	Sub-Area Area (ac)	Curve Number
W2	Open space; grass cover 50% to 75% (fair)	C	4.134	79
	Open space; grass cover 50% to 75% (fair)	D	4.136	84
	Total Area / Weighted Curve Number		8.27 =====	82 ==

Worksheet
Worksheet for Triangular Channel

Project Description	
Worksheet	East Dike/Ditch
Flow Element	Triangular Char
Method	Manning's Form
Solve For	Channel Depth

Input Data	
Mannings Coeff	0.030
Slope	007700 ft/ft
Left Side Slope	3.00 H : V
Right Side Slope	2.00 H : V
Discharge	36.26 cfs

Results	
Depth	1.90 ft
Flow Area	9.1 ft ²
Wetted Perim	10.28 ft
Top Width	9.52 ft
Critical Depth	1.67 ft
Critical Slope	0.015419 ft/ft
Velocity	4.00 ft/s
Velocity Head	0.25 ft
Specific Energy	2.15 ft
Froude Number	0.72
Flow Type	Subcritical

← FLOW DEPTH < HEIGHT OF DIKE - OK